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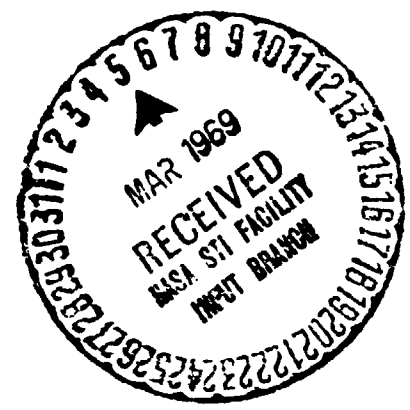
K-V-05.13/4

APOLLO/SATURN V

FLIGHT SAFETY PLAN

VEHICLE AS-504



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VEHICLE AS-504

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LIST OF EFFECTIVE PAGES

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SECTION I
INTRODUCTION

1.1 PURPOSE

This Flight Safety Plan presents flight safety requirements, restrictions, and instrumentation necessary for each launch. The plan defines flight safety responsibilities of the Air Force Eastern Test Range (AFETR) and Kennedy Space Center (KSC). The requirements for flight termination and propellant dispersion are described, and the restrictions and instrumentation applicable for each Apollo/Saturn V flight are listed.

1.2 AUTHORITY

The Flight Safety Plan is authorized within KSC by the Apollo Test Requirements Document, M-D MA 1400, dated May 20, 1964.

1.3 SCOPE

This plan is applicable during the launch countdown and powered flight of the vehicle up to orbit insertion.

SECTION II
FLIGHT SAFETY RESPONSIBILITIES

2.1 AIR FORCE EASTERN TEST RANGE

Agreement NMI 1052.31, dated January 17, 1963,and supplemented by Agreement KMI 1052.1, dated March 9, 1965, places the responsibility for flight safety of all launches from the AFETR and KSC on the Commander of the AFETR. This responsibility includes specifying flight termination system requirements, protecting life and property from an errant vehicle (except within KSC), establishing data requirements and flight safety instrumentation requirements, etc.

2.2 KENNEDY SPACE CENTER

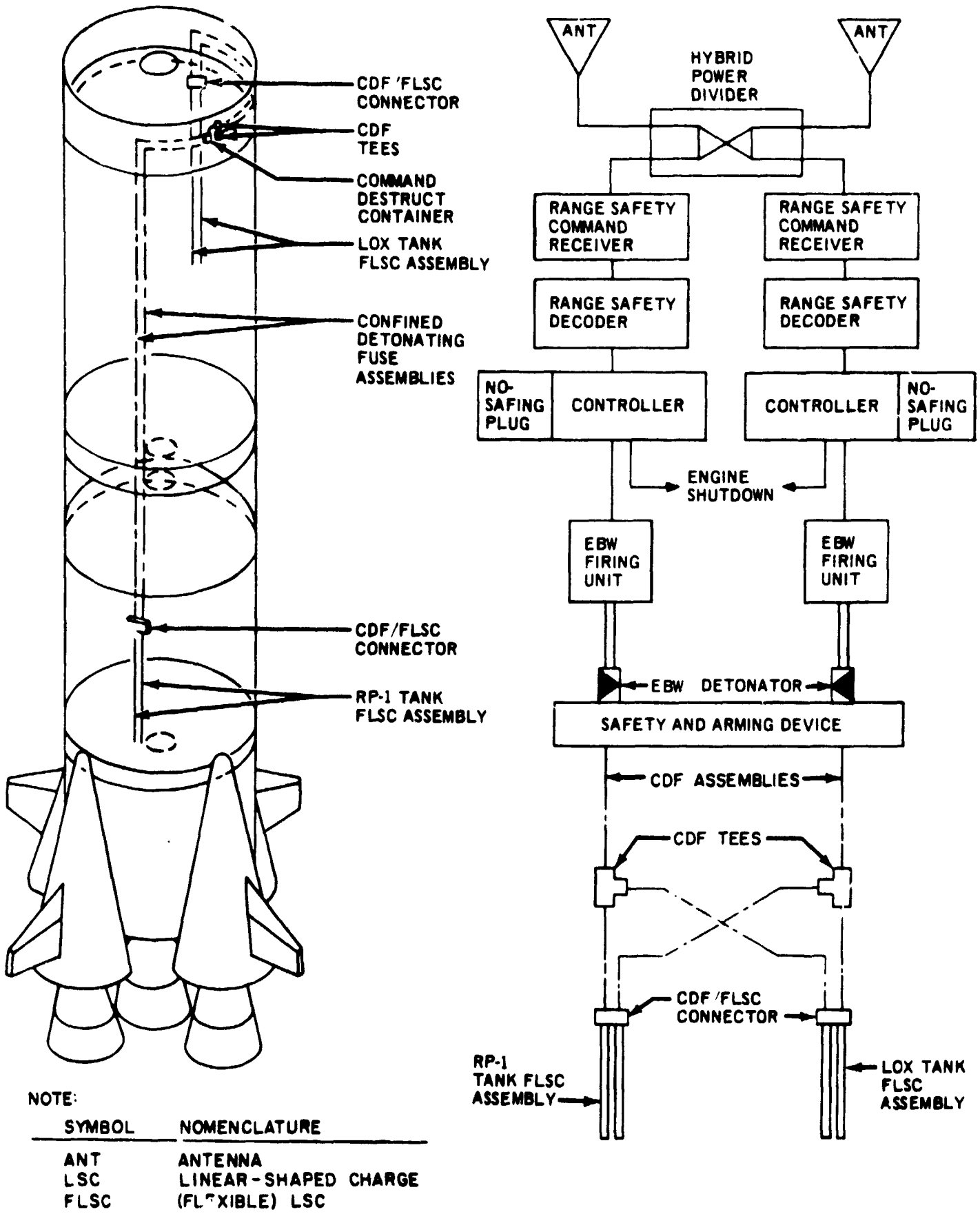
By the same agreements cited in paragraph 2.1, the Director of KSC is responsible for the protection of life and property within KSC from an errant vehicle launched or intended to be launched from Cape Kennedy or KSC. This responsibility includes designating launch danger areas within KSC, clearing these areas during danger periods, etc. Also included is the responsibility for Crew Safety on manned launches from KSC. This responsibility does not include Range Safety Flight Termination control of the vehicle after liftoff, which is the sole responsibility of the Commander of the AFETR. To that extent, the protection of life and property within KSC is a joint effort of KSC and AFETR.

SECTION III
FLIGHT SAFETY REQUIREMENTS

3.1 FLIGHT TERMINATION SYSTEMS

All ballistic or space booster vehicles launched at the AFETR must contain two independent flight termination systems which are compatible with the AFETR ground system. The two systems must be installed on the last power stage and must be capable of destroying all powered stages of the vehicles. For stages that go into orbit prior to ignition, a command system is not required. However, the stage must be capable of being destroyed by command from the preceding stage and also must contain an automatic flight termination system. All stages that do not contain a command system must contain an automatic flight termination system. The automatic flight termination system destroys the thrust capability of the stage in the event of premature separation or breakoff from the other stages carrying a flight termination system. The termination system is automatically activated by mechanical means when premature separation or breakoff occurs. The manned portion of a space vehicle will not require a destruct system on manned flights. Propulsive systems that are not considered as a stage of a vehicle (retrorockets, escape rockets, payloads, etc.) and which present radiological, toxicological, or explosive hazards will require an automatic flight termination system if they have the capability of violating the launch area or flight safety lines. For liquid-propelled vehicles, flight termination action must cause engine shutdown and fuel dispersion or intermixing, depending upon the nature of the propellants.

The Apollo/Saturn V carries two independent flight termination and propellant dispersion systems in each active booster stage. There is no destruct system associated with the Apollo spacecraft. Figures 3-1 through 3-3 pictorially display the Apollo/Saturn V flight termination/propellant dispersion system.



NOTE:

SYMBOL	NOMENCLATURE
ANT	ANTENNA
LSC	LINEAR-SHAPED CHARGE
FLSC	(FLEXIBLE) LSC

Figure 3-1. S-IC Propellant Dispersion System

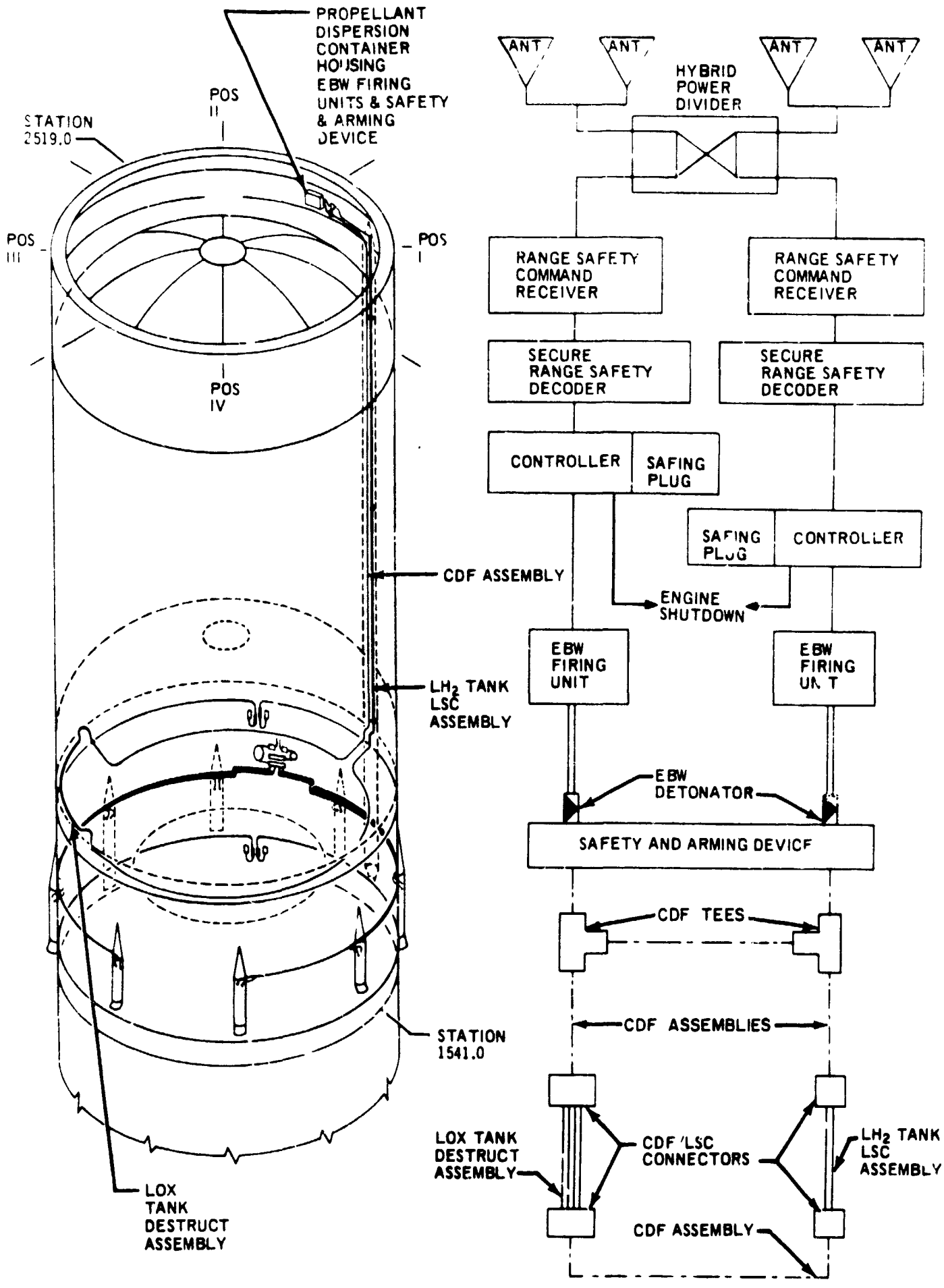


Figure 3-2. S-II Propellant Dispersion System

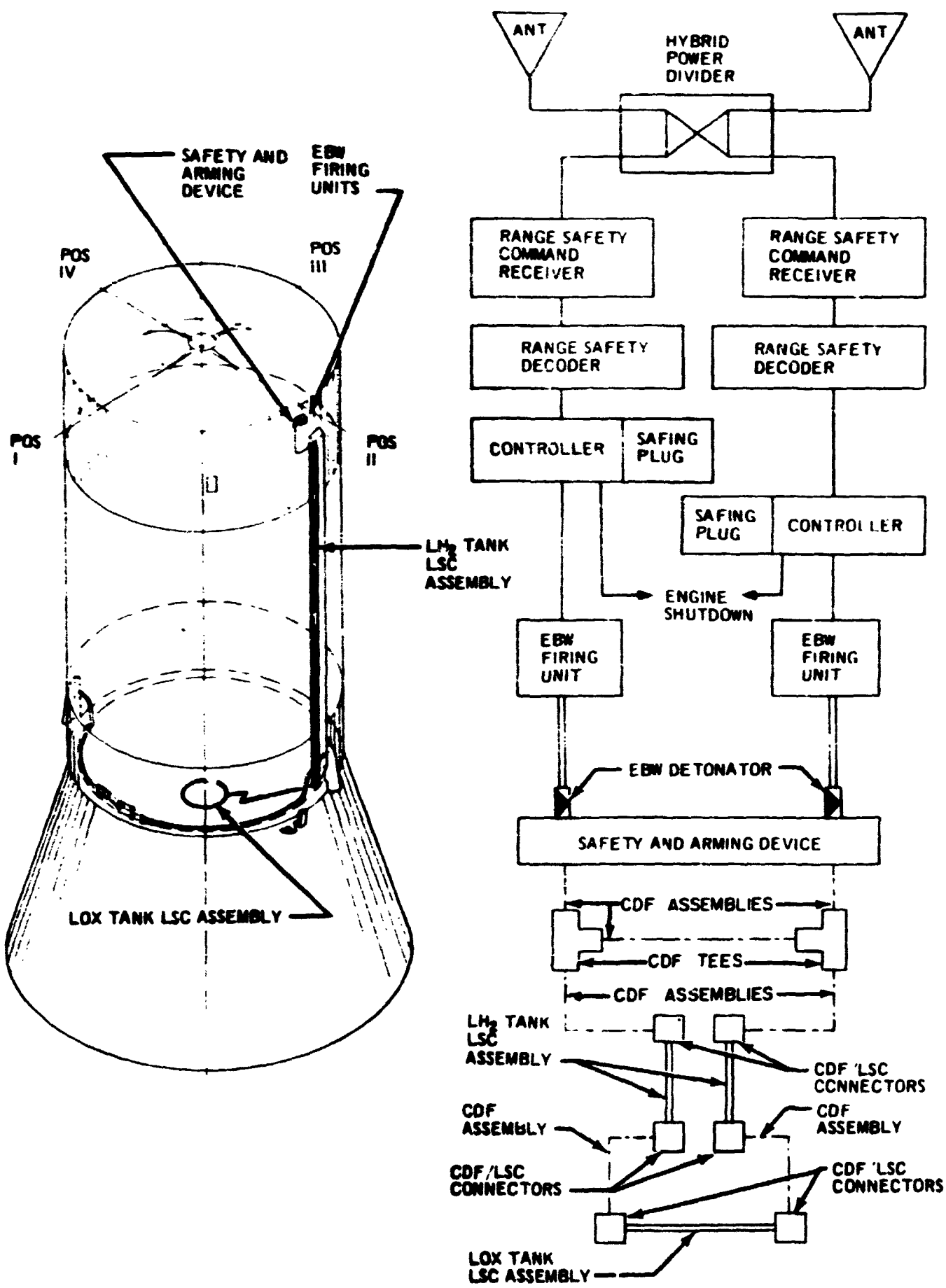


Figure 3-3. S-IVB Propellant Dispersion System

SECTION IV
FLIGHT SAFETY RESTRICTIONS

4.1 PRECEDENCE

The information contained in this section is disseminated several months before launch and is subject to change at any time. In event of conflict between the Flight Safety Plan and the Apollo Mission Rules published for each launch, the Mission Rules shall be considered the official source for procedures or requirements. (The Mission Rules are constantly subject to revision/updating.)

4.2 WEATHER RESTRICTIONS

4.2.1 CEILING. A minimum ceiling height is imposed on all launches. The height of the ceiling is determined by the time required for the launch area radars to acquire the vehicle after liftoff. The minimum ceiling for AS-504 will be 2,000 feet.

4.2.2 VISIBILITY. The vehicle must be visible from the following radar: MILA 19.18.

4.2.3 WINDS. A wind restriction is usually imposed on the launch if the vehicle remains over Cape Kennedy for any length of time. This restriction prevents pieces of a destructed vehicle from drifting into protected areas. The wind restriction for AS-504 is a 1.25 sigma annual wind profile (figure 4-1) applicable to an altitude of 30 kilometers. The critical wind directions are 35 degrees and 105 degrees. In the event this profile is violated by prevailing wind conditions during countdown, the Range Safety Division performs a computer-simulated flight, terminating thrust and breaking the vehicle into pieces at each interval, with the prevailing winds acting on them to determine if the pieces can fall outside the impact limit lines.

4.3 IMPACT LIMIT LINES

4.3.1 CAPE KENNEDY RANGE SAFETY OFFICER ACTION. The impact limit lines to be used for the AS-504 launch are shown in figure 4-2. The Cape Kennedy Range Safety Officer (CKRSO) will take Range Safety action, when necessary, to prevent the vehicle, or pieces thereof, from impacting outside of these boundaries.

4.4 OPERATIONAL RESTRICTIONS

4.4.1 LAUNCH VEHICLE. A restriction has been placed on the booster concerning engine cutoff resulting from an abort action. An airborne timer will be flown in the booster that will prevent, for a stipulated period of time, booster engine cutoff except by Range Safety command. For AS-504, the timer will be set to allow booster engine cutoff by an abort command from T+30 seconds on.

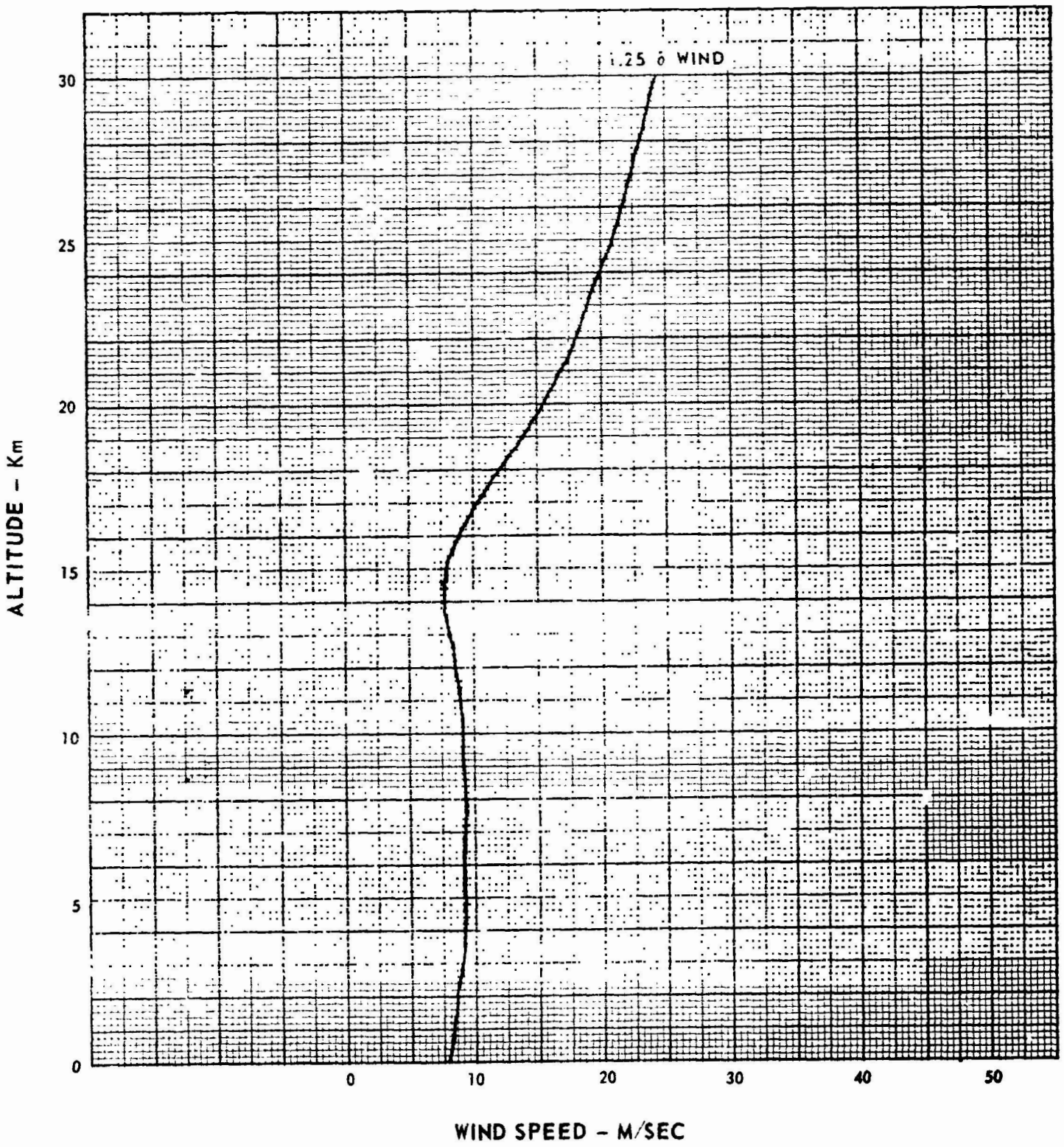


Figure 4-1. 1.25 Sigma Annual Wind Profile

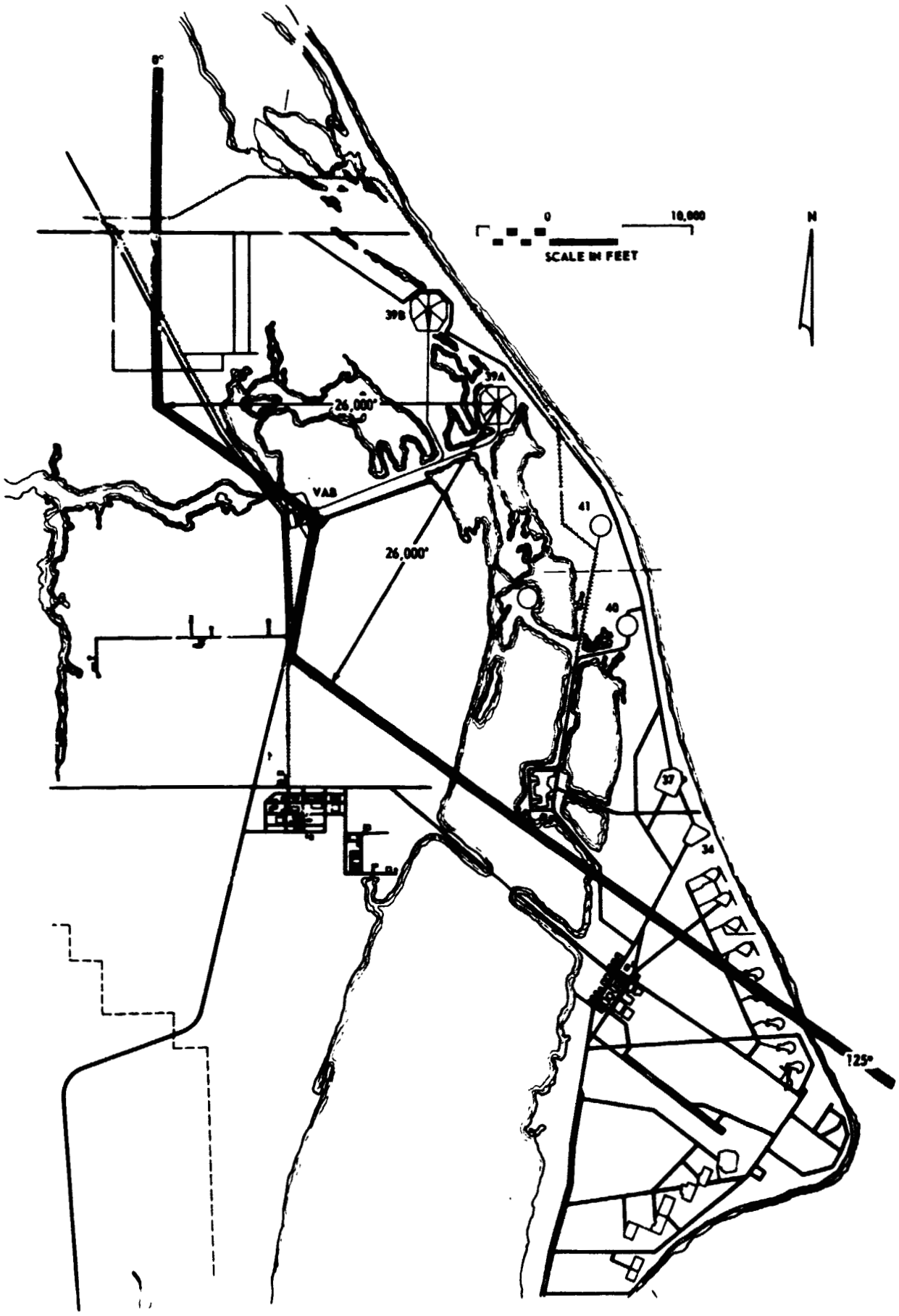


Figure 4-2. Impact Limit Lines for AS-504.

4.4.1.1 Command Receivers. Two operational Range Safety command receivers on each stage (S-IC, S-II, and S-IVB) are mandatory for launch.

4.4.1.2 C-Band Beacons. One of two C-Band Beacons is "MANDATORY" for launch, the other "HIGHLY DESIRABLE."

4.4.2 SPACECRAFT RESTRICTIONS. None.

4.4.3 CREW SAFETY. None.

4.4.4 OTHER CONSIDERATIONS. Other agreements and/or restrictions that have a bearing on the overall flight safety area are given in the following paragrapns:

a. To allow a successful abort of the command module during the S-IC flight, a time delay will be imposed between the commands "ARM" and "DESTRUCT." This interval is governed by a timer on the Range Safety Officer's (RSO) console. For AS-504, the timer will be set for 4.0 seconds.

b. The RSO will accomplish the pad emergency range cutoff procedure if ignition occurs but the space vehicle will not liftoff and NASA is unable to accomplish liftoff. The RSO will send "ARM/MFCO" only in response to a coded verbal request from the NASA Launch Vehicle Test Conductor (CLTC). The CLTC will call the RSO on the greenphone CLTC-RSO link to transmit this request. The RSO will not execute this procedure if he has a liftoff indication.

c. The Flight Director (FD) will initiate abort request in response to a coded verbal request from the RSO. This procedure will be executed if Range Safety flight termination criteria has been violated and RSO efforts to terminate thrust have failed. The request from RSO to FD will be transmitted on the Flight Director loop, with the FIDO-RSO private line as backup.

d. The RSO will send "ARM/MFCO" in response to a coded verbal request from the FD or the Flight Dynamics Officer (FIDO). This procedure will be executed if abort limits have been exceeded and abort action has been unsuccessful. The request from FD/FIDO to the RSO will be transmitted on the Apollo RSO loop, with the FIDO-RSO private line as backup.

e. If Range Safety destruct lines are violated, the RSO will send "ARM/MFCO" and notify the FD/FIDO. No SPS thrusting maneuver will be initiated following such Range Safety action.

f. If the "ARM/MFCO" command is required and transmitted, and an established impact point (IP) is on the Cape Kennedy land area, "DESTRUCT/PD" will be sent. "DESTRUCT/PD" will be used to terminate thrust if an IP cannot be established.

g. When the IP has moved off the Cape, flight termination action will be limited to "ARM/MFCO" or crew initiated abort. The "DESTRUCT/PD" function will be sent as necessary only for dispersion purposes, and only after FD/FIDO confirmation of satisfactory spacecraft separation.

h. If a satisfactory IP is established and "DESTRUCT/PD" is deemed unnecessary, the RSO will notify FD/FIDO and send "SAFE" upon FD/FIDO's request.

i. FD/FIDO will declare to the RSO when there is no possibility of inserting the spacecraft into an orbit, and the RSO will not allow the African gate to be overflown.

j. An ETR Range Safety Officer (BRSO) is required at Bermuda to monitor present position and impact prediction charts, and to transmit the Range Safety functions when commanded to do so by the RSO. The BRSO will assume Range Safety responsibility in the event of loss of communications between the BRSO and the RSO during the period of Bermuda primary command coverage.

k. Safing by the RSO will be done only if the RSO has verification of S-IVB C/O or the FD/FIDO requests "SAFE". When safing is confirmed, the RSO will state to the FD/FIDO "SAFING CONFIRMED".

l. If safing cannot be confirmed by the RSO, another safing attempt will be made by the RSO on the first orbital pass over the Cape. Coordination will be effected with the Superintendent of Range Operations (SRO) and FIDO to ensure command coverage, noninterference with other command functions, and telemetry display availability. At the agreed time, FIDO will state "COMMAND CLEAR, RSO SEND SAFE." Upon confirmation, the RSO will state, SAFING CONFIRMED."

SECTION V
FLIGHT SAFETY INSTRUMENTATION

5.1 SAFETY DATA SOURCES

The AFETR requires that at least two different and adequate sources of safety data for each phase of powered flight be operational at launch. An "adequate" source is defined as one which can protect the applicable impact limit line without endangering a normal vehicle. The RSO will ensure that the adequate data source requirement is met and that those requirements designated "critical" are provided before giving a launch clearance. Those items designated "critical" for AS-504 and therefore mandatory for launch are:

a. Impact Predictor.
b. Bermuda Command Control Transmitter.
c. Bermuda FPS-16, Bermuda FPQ-6, Grand Turk FPQ-18 (2 of 3).
d. IU C-Band Beacons. (1 of 2)

Instrumentation available during S-IC stage powered flight is:

a. High Resolution Trackers (HRT) 1 & 2.
b. KSC TPQ-18 C-Band Radar (19.18).
c. Patrick AFB FPQ-6 C-Band Radar (0.18).
d. Glotract Station I.
e. Program and Flightline Electronic Sky Screen Equipment (ELSSE).
f. Cape FPS-16 C-Band Radar (1.16).
g. Offset Doppler (ODOP).
h. GBI TPQ-18 C-Band Radar (3.18).

Instrumentation available during S-II stage powered flight is:

a. Cape FPS-16 C-Band Radar (1.16).
b. MILA TPQ-18 C-Band Radar (19.18).
c. Patrick AFB FPQ-6 C-Band Radar (0.18).
d. GBI TPQ-18 C-Band Radar (3.18).
e. Grand Turk TPQ-18 C-Band Radar (7.18).
f. Bermuda FPS-16 C-Band Radar.
g. Bermuda FPQ-6 C-Band Radar.
h. Flightline ELSSE.
i. Glotrack Station I.
j. Antigua FPQ-6 C-Band Radar (91.18).

Instrumentation available during S-IVB stage powered flight is:

a. Grand Turk TPQ-18 C-Band Radar (7.18).
b. Bermuda FPS-16 C-Band Radar.
c. Bermuda FPQ-6 C-Band Radar.
d. Antigua FPQ-6 C-Band Radar (91.18).

APPENDIX A
DOCUMENT CATEGORIES

APOLLO/SATURN V
FLIGHT SAFETY PLAN
VEHICLE AS-504

Category	Brief Description of Related Contents	Emphasis Pri.	Emphasis Sec.	See Page(s)
11. Safety	Plan presents flight safety requirements, restrictions, and instrumentation necessary for each Apollo/Saturn V launch.	X		1-1